AOIT Computer Systems

Lesson 9

Computer Hardware Safety

Student Resources

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Student Resource 9.1

Worksheet: Find the Myth

Student Names:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date:\_\_\_\_\_\_\_\_\_\_\_\_

Directions: One of the following statements about safety and environmental concerns regarding computers is commonly believed but is not true. Work in your group and try to figure out which one is the myth. Record your reasons on this worksheet. Be prepared to share your guess and reasoning with the class.

|  |  |
| --- | --- |
| Sometimes recycling computers for their parts isn’t worth the cost of dismantling them. | |
| My guess: | Real Myth |
| My reason: |  |
| CRT monitors are extremely dangerous because they can implode. | |
| My guess: | Real Myth |
| My reason: |  |
| The amount of static you can build up in your body by walking across a carpet is not enough to be dangerous to you and cannot damage your computer hardware. | |
| My guess: | Real Myth |
| My reason: |  |

Student Resource 9.2

Reading: Environmental Concerns   
Regarding Computers

Electronic equipment contains toxic materials such as lead, mercury, chromium, cadmium, and beryllium. When computer equipment is disposed of improperly, these toxins can be released into the environment.

Because the average color cathode-ray tube (CRT) monitor contains four to five pounds of lead in addition to other hazardous materials, it is a major environmental concern. Federal environmental law includes guidelines for disposing of computer CRT monitors. CRTs sent for disposal must be declared as hazardous waste and sent to a permitted hazardous waste landfill.

Environmentally sound management principles control the storage, transport, treatment, reuse, recycling, recovery, and final disposal of hazardous waste, including electronic equipment.

Material Safety Data Sheets

Material safety data sheets (MSDS) catalog data regarding the properties of chemicals, compounds, and chemical mixtures. An MSDS form details the proper procedures for handling a chemical safely.

An MSDS must be completed when transferring possession of hazardous materials, regardless of who is responsible for their final disposal. It is required when disposing of hazardous material such as asbestos, lead, fiberglass, and mercury. An MSDS includes information about these chemical products, including:

* Melting point, boiling point, and flash point
* Toxicity and health effects
* First aid treatments
* Storage and disposal
* Spill and leak handling procedures

MSDS forms are not meant for general consumers, but for workers and others who deal with hazardous material as part of their jobs. MSDS forms are used by:

* Employees who might be exposed to a chemical hazard at work
* Employers who need to know how to protect their workers and the workplace
* First responders such as firefighters, hazardous material crews, emergency medical technicians, and emergency room personnel

MSDS forms are kept on file wherever chemicals are used. They typically are two to four pages long but vary depending on their format and content. You can get them from universities, science libraries, and the Internet. You can also order them from the company that manufactured or distributed the chemical.

Computer Disposal Is a Global Issue

The US Environmental Protection Agency (EPA) estimates that more than 45 million computers become obsolete annually. The US government alone disposes of approximately 10,000 computers every week. Many of these computers end up in storage, warehouses, and landfills, or are shipped to overseas locations that have lower environmental standards.

Many states have already outlawed the disposal of computer waste in landfills, but the environmental concerns reach beyond state and even federal borders. In 1989, the United Nations Environment Programme launched the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal. More than 170 governments and other parties have signed this treaty, which uses the principles of environmentally sound management to protect human health and the environment from the dangers posed by hazardous wastes.

The Basel Convention sets out a three-step strategy for (1) minimizing waste generation, (2) treating wastes as near as possible to where they were generated, and (3) reducing international movements of hazardous wastes. Similarly, the US EPA’s preferred order of environmentally sound management of solid waste is:

1. Waste prevention
2. Recycling
3. Disposal

Waste Prevention

If less waste is produced, less money, work, and risk is required to clean it up. Reducing waste at the source is the most efficient method of minimizing waste.

Successful manufacturers of the future will minimize hazardous components and by-products and will increasingly recycle leftover materials back into the manufacturing cycle. Many companies, such as Apple Inc., Dell, and Hewlett-Packard, have already demonstrated that this strategy can be both economically efficient and environmentally safe.

Consumers also need to educate themselves about what they buy every day. An important aspect of waste reduction is to lower consumer demand for products and services that result in hazardous by-products. Consumers must realize they can be a vital part of the solution.

Reusing and Recycling Computers

Reusing computers refers to donating, giving, or selling them to someone else to use. Sometimes the time and effort to sell these computers is not worth the value of the used computer. Donating computers to charitable organizations and schools yields tax benefits that help make the effort worthwhile. Before computers are donated for reuse, the hard drive should either be destroyed or be totally reformatted.

When reusing or refurbishing computers is not an option, recycling them for their parts is the next best solution. In many cases, however, the value of the equipment doesn’t cover the cost of dismantling it. Recycling is the best option for computers that are old or broken, especially monitors.

Some states have voluntary recycling programs and have convenient drop-off locations for computers. Some municipalities pick up old computer equipment on monthly, quarterly, or annual computer recycling days.

In addition, most major computer manufacturers have trade-in programs. Recent proposed state legislation will force more manufacturers to implement trade-in programs.

Safe Disposal

Obsolete or broken computer parts that aren’t candidates for reuse or recycling must be disposed of. Proper disposal procedures are often governed by local regulations. Consult your city, county, or state environmental laws that govern disposal of computers, peripherals, monitors, and circuit boards and expansion cards. Because of their high voltage and ability to implode, monitors must be disposed of with extreme caution.

Student Resource 9.3

Worksheet: Keeping You and Your Computer Safe

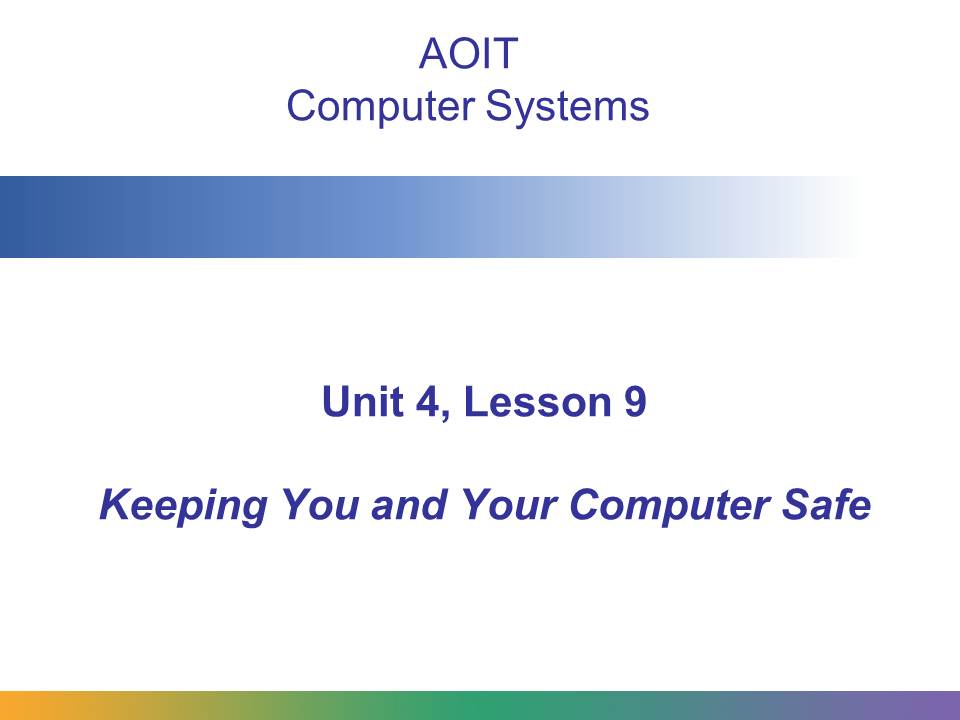
Student Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date:\_\_\_\_\_\_\_\_\_\_\_\_

Directions: Fill in the middle column of this worksheet with information that you already know or that you can find on the Internet. Fill in the third column with information you learn in the presentation about this topic.

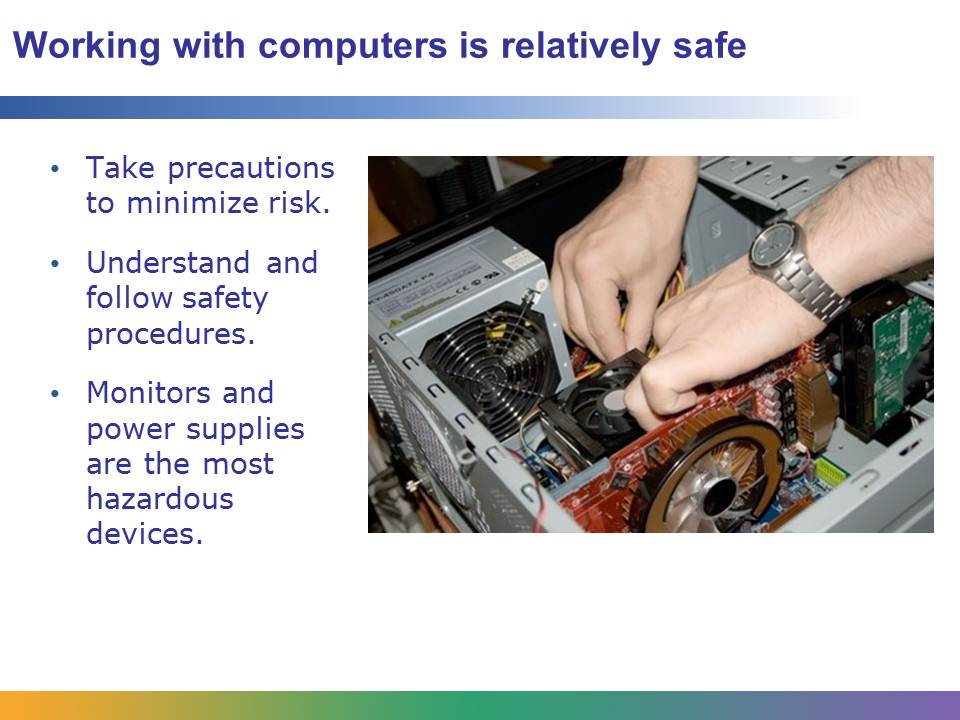
|  |  |  |
| --- | --- | --- |
| Concept Name | What I Already Know or  Think Is True | What I Learned |
| static electricity |  |  |
| electrostatic  discharge (ESD) |  |  |
| grounding |  |  |
| antistatic  wrist straps |  |  |
| antistatic mats |  |  |
| CRT monitors |  |  |
| power supplies |  |  |
| electromagnetic interference (EMI) |  |  |

Student Resource 9.4

Reading: Keeping You and Your Computer Safe



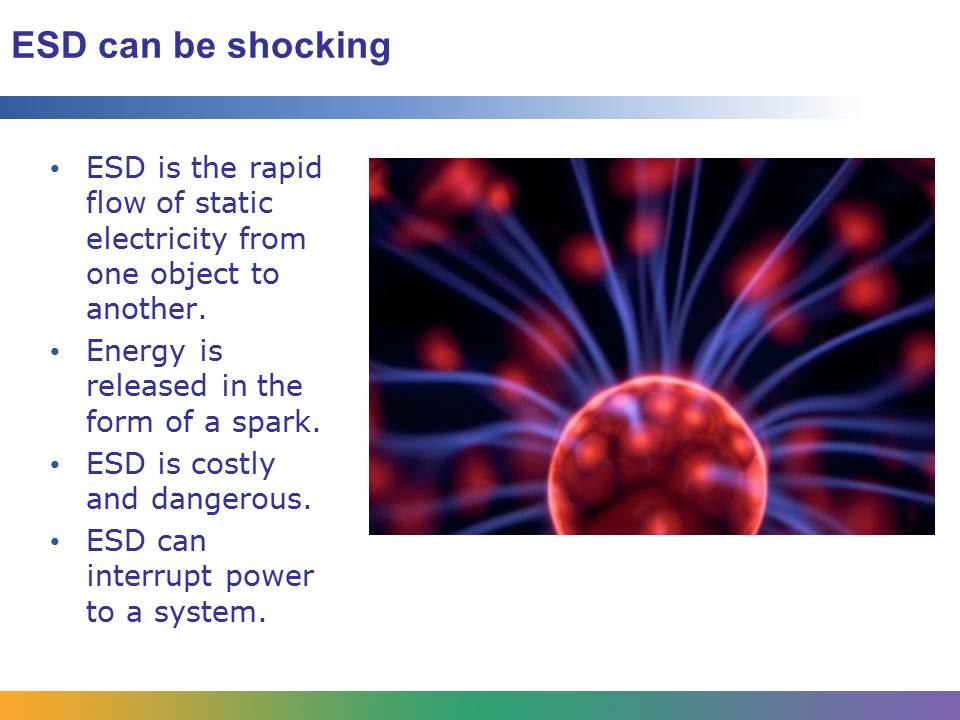
This presentation discusses electricity in the computer environment and explains important safety considerations to keep in mind while working on computers.



Working with computers is a relatively safe occupation. But, like any profession that requires working with electrical equipment, it involves risk. Computer technicians should take every precaution to minimize the risk of personal injury and damage to equipment.

Damage to expensive computer components costs millions of dollars every year. Make sure that you understand and follow safety procedures in order to reduce equipment losses.

Electrical devices pose the greatest risk of injury to a computer technician. Monitors and power supplies are the most hazardous of these devices.



Electrostatic discharge (ESD) is the rapid flow of static electricity from one object to another, usually when those objects are close to each other. If there is not a safe path for this flow, energy is released in the form of a spark. Often, nothing is visible, but there is still a discharge.

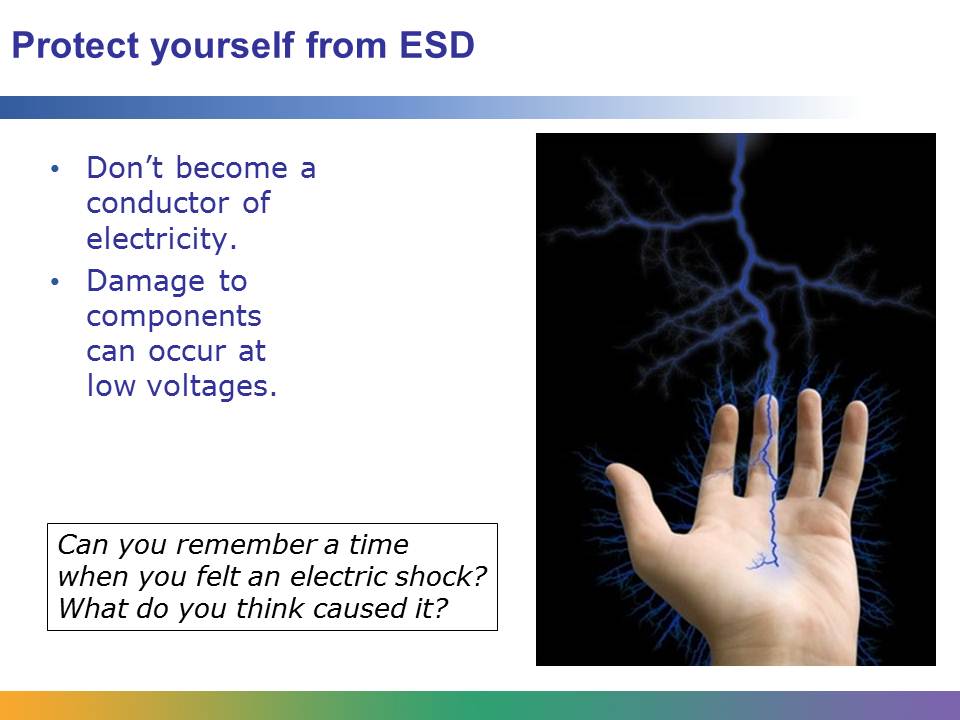
For example, when you walk across a carpet, you can build a static charge of up to 50,000 volts. When you touch another object, you discharge static electricity. When the electrical discharge moves between you and the object, you feel a shock as a result of ESD.

In winter, it is common for people to have a charge on their hands of 400 volts or more. Humid conditions lessen the buildup of static charges.

ESD is a problem in many industrial environments, with expensive and dangerous consequences. In the computer industry, ESD can cause the following problems:

* Electrical shock and injury to employees
* Fires when static discharge ignites flammable solutions
* Damage to sensitive computer components

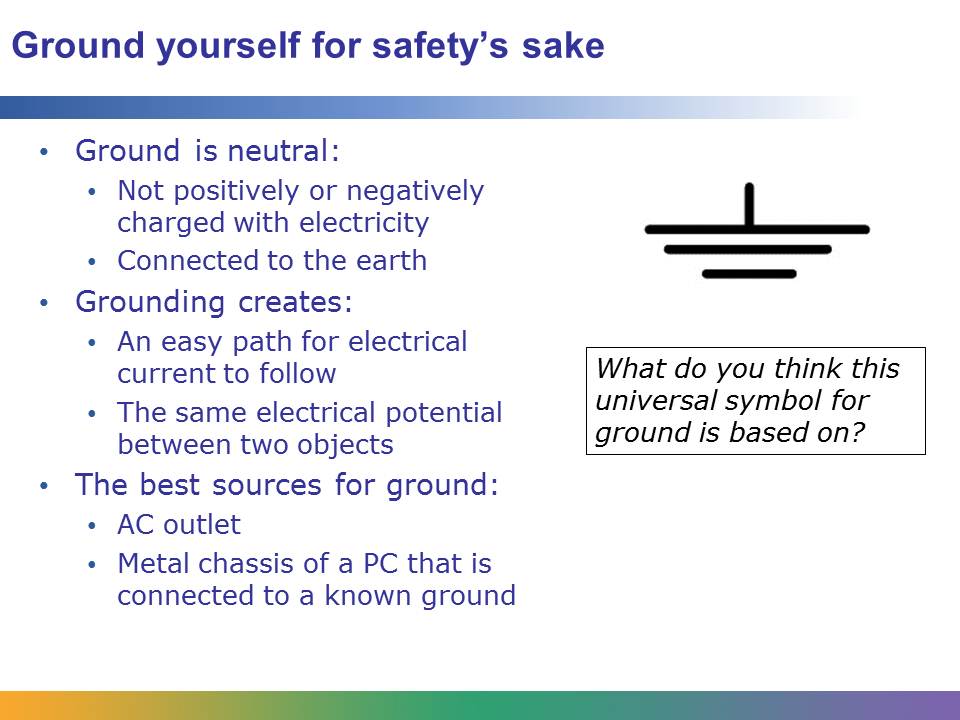
ESD can also interrupt the power to a system. This loss of connection can impact the productivity of a business, causing further loss of data and time.



Because your body can hold a large static charge, you should be careful not to become a conductor of electricity.

Take care to protect yourself and expensive computer components from ESD. Although an electrostatic charge must carry 3,000 volts before you can feel a shock, damage to components, such as RAM or CMOS chips, can occur at much lower voltages.

Newer computer components are usually smaller and more complex in design. They are even more sensitive to ESD. A charge as low as 20 volts can cause catastrophic damage, resulting in immediate failure, or latent damage, where the component seems to be working fine only to fail unexpectedly some time later.



To prevent injury to yourself and damage to components such as boards, chips, or other electronics, you should be grounded. The term *ground* refers to any material, such as the earth, that is neutral, or not positively or negatively charged with electricity. To be grounded is to be connected to the earth or any other known ground source.

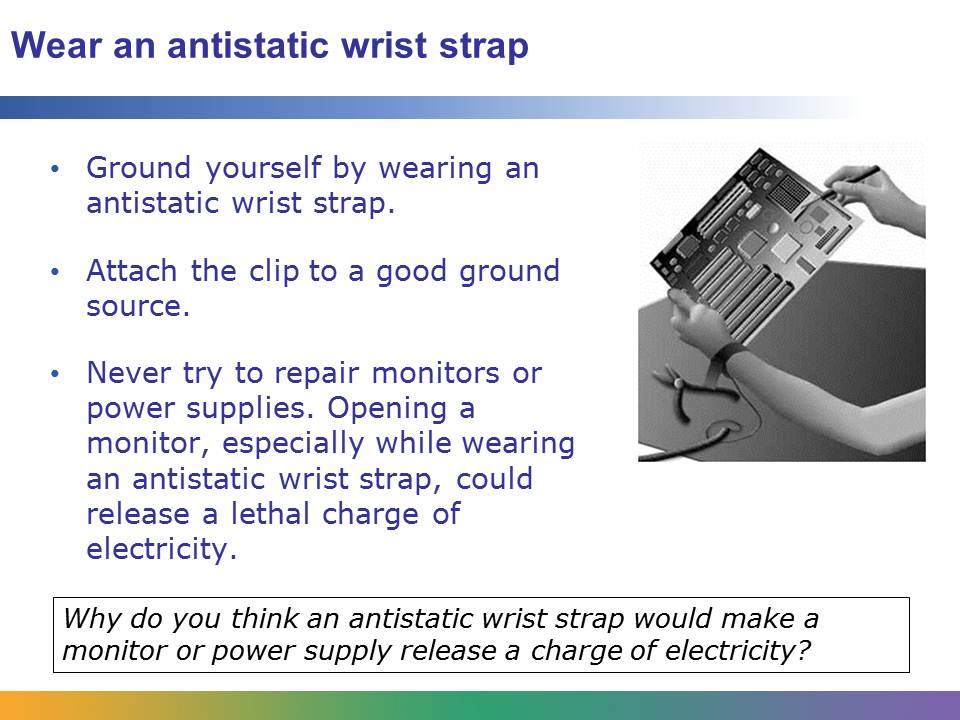
Grounding protects people and objects from lethal or destructive charges of electricity by creating the following:

* An easy path for electrical current to follow, diverting electric current around people and objects
* The same electrical potential between two objects

When you work with computer components, the best sources for grounding include the following:

* AC outlet
* Metal chassis of a PC that is connected to a known ground

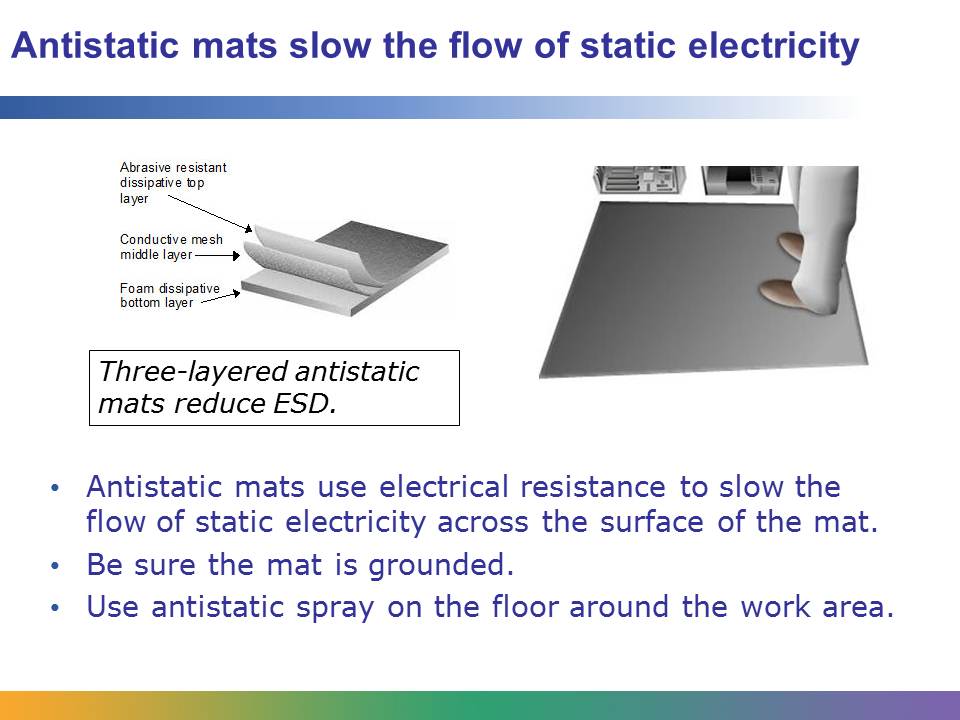
Ground yourself by touching the bare metal of a computer chassis before working on the computer or its components.



One precaution you should take is to ground yourself by wearing an antistatic wrist strap. An ESD wrist strap consists of a strap attached to a ground wire with a metal alligator clip at one end. A small resistor designed to control the electrical discharge is located within the wire.

When working with computers, you should always wear the wrist strap with the clip attached to a good ground source. Some computer technicians attach the clip to the metal frame of the computer case or to an ESD tester.

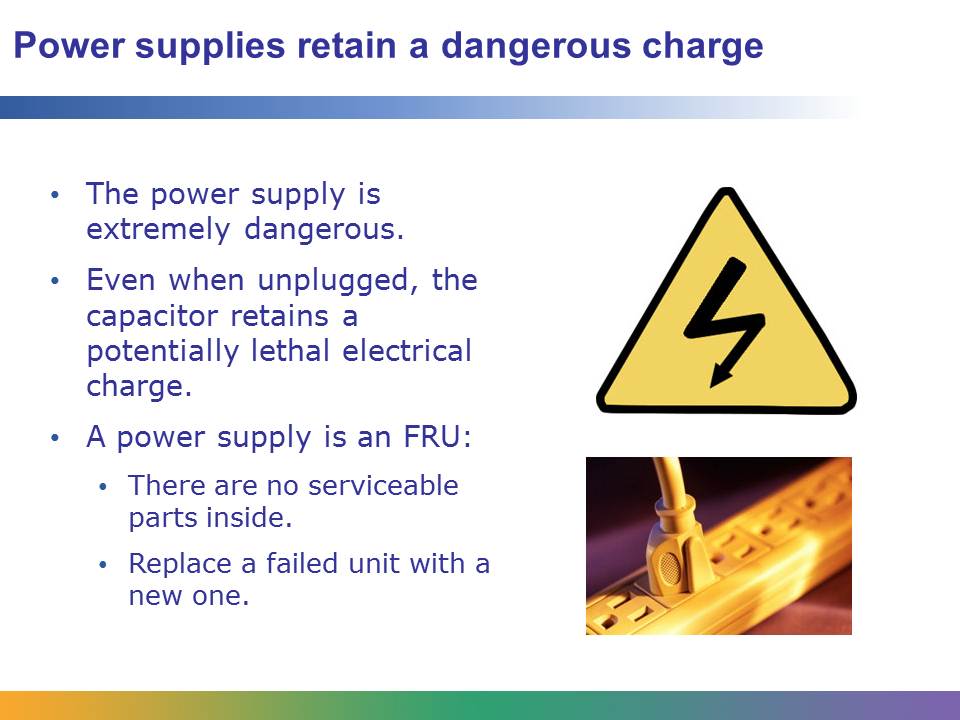
You should *never*wear a wrist strap while working with a monitor or an open power supply. Repairing monitors and power supplies is extremely dangerous and should not be done. Monitors and power supplies are considered field replaceable units (FRUs), which means that they should be replaced rather than repaired. It is cheaper and much safer to dispose of broken monitors and power supplies and replace them with new ones.



Antistatic mats are also important pieces of protective equipment for grounding. Antistatic mats use electrical resistance to slow the flow of static electricity across the surface of the mat. When the mat is grounded, ESD will flow to ground; this neutralizes the ESD and protects sensitive computer components.

Before you begin to work on a computer, lay an antistatic mat on your worktable, and place the computer and its components on the mat. You should also use an antistatic floor mat. Check the grounding cable from the antistatic floor mat to ensure that there are no defects that will prevent the cable from grounding properly.

To further reduce the risk of ESD, apply generous amounts of antistatic spray on the floor surrounding the work area. You can make your own antistatic spray by mixing fabric softener and water.



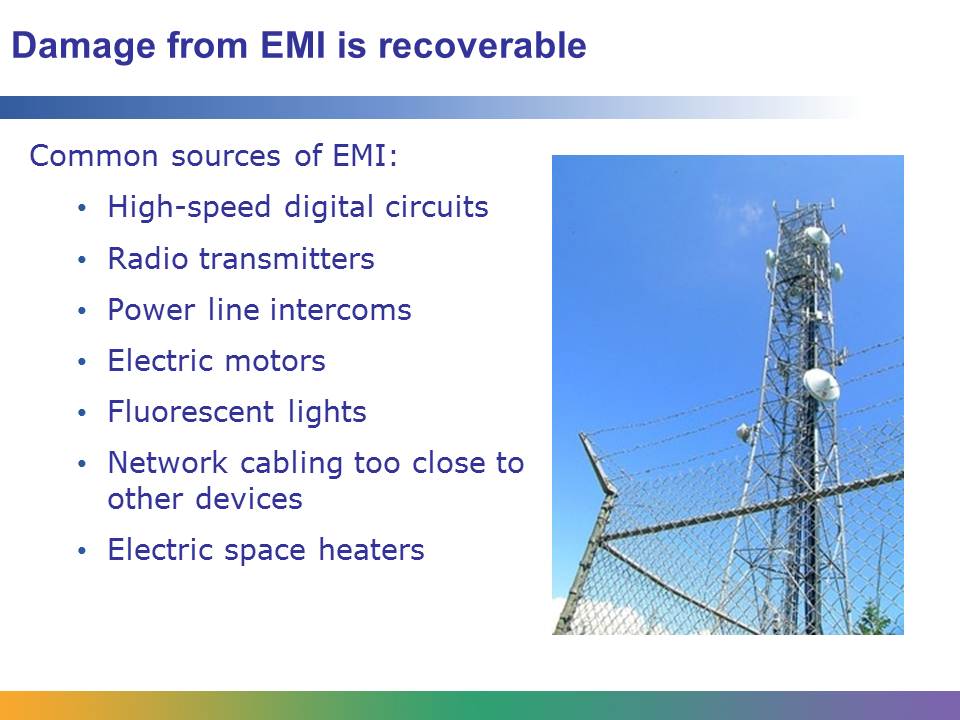
The computer’s power supply is an extremely dangerous component. Even when left unplugged, the power supply’s capacitor retains a potentially lethal electrical charge.

Like a monitor, a power supply is an FRU. The power supply case carries a warning label stating that there are no serviceable parts inside and that it is best to replace the failed unit with a new one.



To further minimize the risk of ESD damage to your computer components, follow these tips:

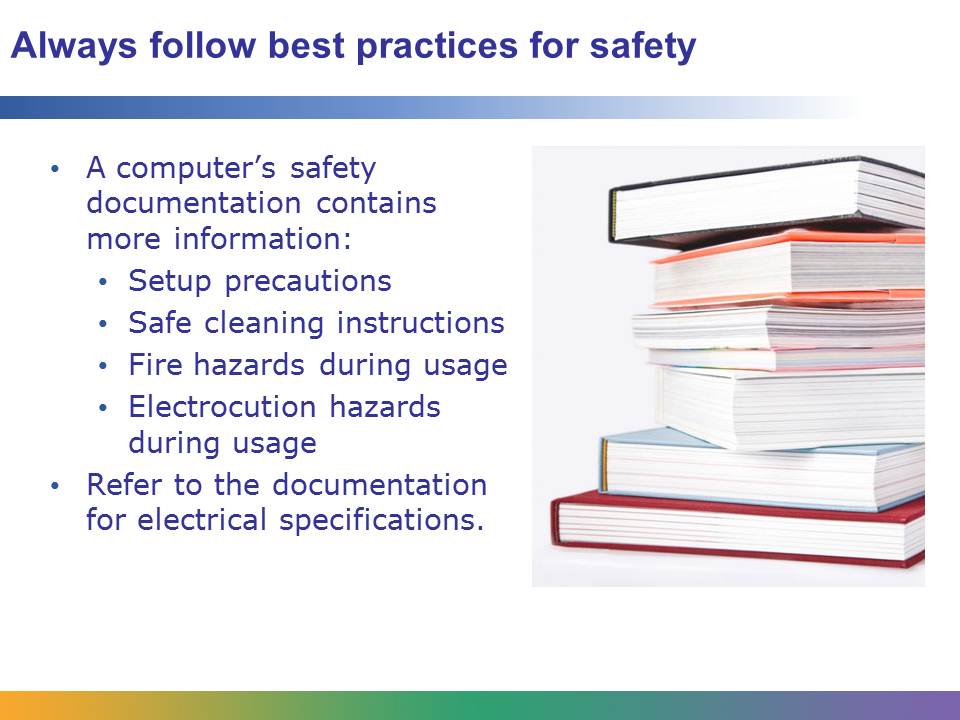
* To protect sensitive computer components from ESD, store them in antistatic bags. Remove them from the bag slowly to avoid creating an electrostatic charge.
* Ship ESD-sensitive components in an antistatic shipping bag.
* Maintain humidity levels between 70% and 90%. The highest risk for ESD damage happens when humidity levels are low.
* Never touch the electrical contacts on components.



*Electromagnetic* *interference* (EMI)is AC current produced by electromagnetic devices, natural phenomena, or high-frequency radio waves. Sources of this type of current create electromagnetic fields that interfere with the operation of nearby electronic equipment.

EMI can cause computers to malfunction. However, unlike ESD, which can permanently damage or destroy components, EMI can be avoided, and its effects can be reversed.

For a real-world example of EMI, place your cell phone next to a computer that has its external speakers turned on. Then have a friend call your cell phone. The Morse code–like sound you will hear coming from the speakers is the EMI being produced by your cell phone.



To ensure a safe working environment around computers, always follow best practices.

You can find more information in the electrical and mechanical safety documentation that comes with computers and computer parts. This information includes the following:

* Setup precautions
* Safe cleaning instructions
* Fire hazards during usage
* Electrocution hazards during usage

You can also refer to the documentation for electrical specifications of the computer and other devices. Knowing these specifications will help you avoid exceeding the wattage capacity of the device. This in turn minimizes the risk of fire.

Student Resource 9.5

Reference Sheet: Opening and Cleaning a Computer

Student Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date:\_\_\_\_\_\_\_\_\_\_\_\_

Directions: Follow the guidelines in this reference sheet as you clean your computer. When you finish each section, make notes on this sheet about anything unusual that happened or any questions you have.

Cleaning Tools

* Use a clean, soft, lint-free antistatic cloth to clean the outside of the case, the mouse, and the monitor. Do not use a cloth to clean the motherboard, RAM, or other circuit boards.
* Use only water or rubbing alcohol with the cloth when cleaning the inside of the computer. You can use the water and vinegar solution for the outside of the computer.
* Never use a strong solvent to clean the inside or the outside of a computer. Never put any liquids inside the computer. Always apply the cleaning liquid to the cloth (barely damp) and not to the computer directly.
* Cotton swabs dipped in rubbing alcohol or water work well for small areas in the keyboard, mouse, and other locations. Do not use a cotton ball because it can leave fibers behind.
* Use a can of compressed air to blow air into the CD drive and to loosen any dust that might be inside.

**My notes:**

General Cleaning Tips

* Always turn off the computer and components before you start. **Be sure to unplug all the power cords.**
* In general, you should try to clean your computer every three to six months, more often if you use it often and it’s in a dusty environment.
* Be sure to follow antistatic and other safety procedures when working inside your computer.
* Wipe down the outside of your computer with a solution of one-half vinegar and one-half water to minimize static, which attracts dust.
* Touch as little as possible inside the computer, keeping fingers away from cards and cords.
* Never get any circuit board or any other internal component damp or wet. If you need to use a spray, spray the liquid onto a cloth and then use that cloth to wipe off the component.
* Never use an outlet-powered vacuum inside your computer; it generates a lot of static electricity that can damage the components. Only use portable, battery-powered vacuums that are specifically designed for cleaning computers.
* Never eat or drink around your computer.

**My notes:**

Cleaning Outside the Chassis

Before beginning to work on your computer, either wear an antistatic wrist strap or ground yourself by touching a bare metal spot on the chassis frame.

Slightly dampen the clean antistatic cloth with the mixture of vinegar and water. Use the cloth to wipe off any dirt or grime on the outside chassis cover. Be careful around the front panel, taking care not to get any of the vinegar and water solution inside the CD-ROM drive or near the power or reset buttons.

Open the CD-ROM drive and use the can of compressed air to blow air into the moving parts in the tray. Keeping the nozzle at least four inches away from the inside of the drive, blow air into the opening to loosen any dust that might be inside. Be sure to try and angle the air so that it has an escape route from the inside of the CD-ROM drive. That way you avoid just cramming the dust deeper into the drive.

Wipe down the back of the chassis with a barely damp cloth, being careful around the connectors. Do not use any liquid near the ports, outlets, or power connectors. Clean any dust that might have accumulated on the grid covering the fan, again being careful not to get any liquid inside the computer.

**My notes:**

Cleaning Inside the Chassis

The most important part of the computer that needs to be cleaned is the inside. Dust can clog the vents in the back of the chassis, decreasing the air flow and heating up the processor. Dust can also interfere with the connections between the motherboard and the circuit boards.

Before opening the computer, ground yourself again by touching a bare metal spot on the chassis. Then use a screwdriver to remove the cover of the chassis that is on the opposite side of the motherboard. (Some modern computer chassis—for example, most Dell computers—have screwless designs. If you are cleaning one of these computers, try to find the release mechanism to open the chassis. If you can’t find it, consult the manufacturer’s instructions.)

From the back of the case, blow air from the canned air into the power supply box and the fan. Keeping the nozzle at least four inches away from the parts, blow air around the components and along the bottom of the chassis. Blow the dust in one direction to move it out of the case. Again, be sure to avoid blowing the air at an angle that will just end up cramming the dust deeper into the components—your goal is to get the dust out, not just move it around!

Using a cotton swab, carefully and gently clean all the circuit boards, underneath the motherboard, and the drives. Look for dust or grit that might be causing the expansion cards to make poor connection with the motherboard. Gently run the tip of the cotton swab along the point of contact of any filled slots and at the edge of any empty slots on the motherboard.

Use the damp cloth to clean the surface of the inside cover. Be sure it is completely dry before putting it back on the chassis and replacing the screws.

My notes:  
Student Resource 9.6

Writing Assignment: Safety Checklist

Student Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date:\_\_\_\_\_\_\_\_\_\_\_\_

Directions: Using your notes from the readings and your homework, create a safety checklist that includes all of the best practices you have learned for working inside a computer. Put the steps in the order that you would perform them, so you won’t forget anything. You can use as many bullets per section as you need. Before you begin, review the assessment criteria on the next page to make sure you create a quality checklist.

Preliminary Safety Precautions

* Use an antistatic wristband.

From the Outside

* Wipe down the outside only with vinegar and water.

Before Opening the Computer

* Turn off the computer.

When Cleaning the Inside

Before Closing Up the Computer

* Clean the inside cover.

Notes:

Make sure your checklist meets or exceeds the following assessment criteria:

* The information lists only things that are really important.
* The language is clear and specific.
* All preliminary safety precautions are listed correctly.
* All cleaning and safety steps to take on the outside of the computer are included.
* Safety steps to take before opening the computer are complete and correct.
* Safety steps to take when cleaning the inside of the computer are complete and correct.
* All steps to take before closing up the computer are complete and correct.

Student Resource 9.7

Worksheet: Power Fluctuations

Student Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date:\_\_\_\_\_\_\_\_\_\_\_\_

Directions: As you listen to your teacher talk about the types of power fluctuations, take notes on this worksheet.

|  |  |  |  |
| --- | --- | --- | --- |
| **Type of Fluctuation** | **What It Is** | **What It Does** | **How to Protect Against It** |
| Blackout and brownout |  |  |  |
| Power surge |  |  |  |
| Power sag |  |  |  |
| Electrical noise |  |  |  |

Further research: Find a computer in your classroom or at home. Which power fluctuations (if any) is it protected against, and how can you tell?